
PART I - ADMINISTRATIVE

Section 1. General administrative information

Title of project

Hungry Horse Mitigation - Nonnative Fish Removal / Hatchery Production

BPA project number: 9101904

Contract renewal date (mm/yyyy): 10/1999 ☐ **Multiple actions?**

Business name of agency, institution or organization requesting funding

U.S. Fish and Wildlife Service - Umbrella Subproposal

Business acronym (if appropriate) USFWS

Proposal contact person or principal investigator:

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NPPC Program Measure Number(s) which this project addresses

10.3A.10, 10.3A.11, 10.3A.12

FWS/NMFS Biological Opinion Number(s) which this project addresses

Bull Trout ESA Listing (63 FR 31647)

Westslope Cutthroat Trout Petitioned (63 FR 31691)

Other planning document references

Fisheries Mitigation Plan for Losses Attributable to the Construction and Operation of Hungry Horse Dam; by Montana Fish Wildlife and Parks (MFWP) and Confederated Salish and Kootenai Tribes (CSKT); approved by NPPC November, 1991.

Hungry Horse Dam Fisheries Mitigation Implementation Plan; by MFWP and CSKT; approved by NPPC March, 1993.

Flathead River Drainage Bull Trout Status Report; Montana Bull Trout Scientific Group 1995.

Short description

Conduct nonnative fish removal in Lake McDonald in Glacier National Park to facilitate restoration of native bull trout and westslope cutthroat trout in the Flathead drainage; produce hatchery fish for offsite stocking to mitigate Flathead Lake losses.

Target species

Westslope Cutthroat Trout, Bull Trout

Section 2. Sorting and evaluation**Subbasin**

Flathead

Evaluation Process Sort

CBFWA caucus	Special evaluation process	ISRP project type
Mark one or more caucus	If your project fits either of these processes, mark one or both	Mark one or more categories
<input type="checkbox"/> Anadromous fish <input checked="" type="checkbox"/> Resident fish <input type="checkbox"/> Wildlife	<input checked="" type="checkbox"/> Multi-year (milestone-based evaluation) <input type="checkbox"/> Watershed project evaluation	<input type="checkbox"/> Watershed councils/model watersheds <input type="checkbox"/> Information dissemination <input type="checkbox"/> Operation & maintenance <input type="checkbox"/> New construction <input type="checkbox"/> Research & monitoring <input checked="" type="checkbox"/> Implementation & management <input type="checkbox"/> Wildlife habitat acquisitions

Section 3. Relationships to other Bonneville projects

Umbrella / sub-proposal relationships. List umbrella project first.

Project #	Project title/description
20554	Hungry Horse Fisheries Mitigation
9101901	Hungry Horse Mitigation - Flathead Lake Monitoring and Habitat Enhancement
9101903	Hungry Horse Mitigation - Watershed Restoration and Monitoring
9410002	Excessive Drawdown Mitigation - Hungry Horse Component

Other dependent or critically-related projects

Project #	Project title/description	Nature of relationship
9502500	Flathead River Instream Flow Project	Umbrella Subproposal
9608701	Focus Watershed Coordination - Flathead River Watershed	Watershed Plan

Section 4. Objectives, tasks and schedules

Past accomplishments

Year	Accomplishment	Met biological objectives?
1993	Initiate hatchery component of 5-year kokanee stocking and monitoring program.	Yes - Over 5 million kokanee stocked in 1993-1997.
1993	Initiate bull trout experimental hatchery development and research.	Yes - Successful production and completion of thyroid hormone and imprinting research.
1995	Develop kokanee broodstock.	Yes - Produced up to 3 million eggs annually 1995-1997.
1997	Initiate offsite westslope cutthroat and rainbow trout stocking.	Yes - 136,000 fish planted in FY98.
1997	Initiate bull trout experimental culture development.	Yes - Successfully reared bull trout to maturity and provided over 200,000 eggs for experimental research programs.
1997	Develop Sekokini Springs Natural Rearing Facility fish culture program.	Partial - Successful initiation of fish culture activities and production in hatchery .
1998	Evaluate success of kokanee program.	No - Failed to produce significant fishery and/or meet survival objectives due to excessive predation by lake trout.

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Produce native westslope cutthroat trout at Creston NFH.	a	Acquire eggs and rear up to 100,000 westslope cutthroat trout annually for offsite mitigation stocking.
2	Develop experimental techniques for hatchery culture of bull trout at Creston NFH.	a	Continue experimental evaluation of bull trout broodstock, providing eggs and fry for research purposes.

3	Produce rainbow trout at Creston NFH.	a	Acquire eggs and rear up to 100,000 rainbow annually for CSKT offsite mitigation in closed basin waters.
4	Facilitate native species recovery in Lake McDonald in Glacier National Park through a 5-year pilot program to reduce limiting factors.	a	Assess existing fish population structure (species composition, age/growth, relative abundance, genetics, and food habits) in Lake McDonald (FY 2000 - FY 2001).
		b	Assess existing zooplankton community composition and population structure in Lake McDonald (FY 2000 - FY2001)
		c	Evaluate deepwater trapnets, Merwin traps, and/or other techniques for passive capture of native and introduced fishes (FY 2000) in large glacial lakes.
		d	Conduct spawning and recruitment surveys and assess limiting factors for native bull trout and westslope cutthroat trout in tributaries to Lake McDonald (FY 2000 - FY 2004)
		e	Conduct full-scale passive and active removal efforts to eliminate, to the maximum extent practical, all introduced fishes from Lake McDonald; including lake trout, lake whitefish, kokanee, and rainbow trout. (FY 2001 - FY 2002).
		e	Evaluate response of native fish and zooplankton communities to introduced fish species removal efforts (FY 2003 - FY 2004).
		f	Implement habitat restoration actions as needed to improve spawning and recruitment of native bull trout and westslope cutthroat trout (FY 2003 - FY 2004).
		g	Provide long-term recommendations for maintaining the native species complex in Lake McDonald and assess application of these techniques to other waters in Glacier National Park, the Flathead Basin, and the Columbia River system.

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Objective schedules and costs

Obj #	Start date mm/yyyy	End date mm/yyyy	Measureable biological objective(s)	Milestone	FY2000 Cost %
1	7/1997	10/2025			15.00%
2	9/1993	12/1999			8.00%
3	4/1997	10/2025			5.00%
4	10/1999	9/2004	Population Estimates	X	72.00%
				Total	100.00%

Schedule constraints

ESA-related actions such as recovery plans, or permitting for westslope cutthroat trout or bull trout could delay or modify objectives 1 and 4. Objectives 1 and 3 subject to modification by management agencies (MFWP or CSKT).

Completion date

1999 Objective 2; 2004 Objective 4; 2025 or beyond for Objectives 1 and 3.

Section 5. Budget

FY99 project budget (BPA obligated): \$389,400

FY2000 budget by line item

Item	Note	% of total	FY2000
Personnel	Approx 4.2 FTE	%37	159,300
Fringe benefits		%16	68,300
Supplies, materials, non-expendable property	Fish production equipt., PIT tag reader, ropes, anchors, waders, PFD's, anaesthetic, misc. equipt.	%2	10,000
Operations & maintenance	Boat hydraulic retrofit; working barge; vehicle, net, trap maintenance; fish food; chemicals	%17	72,100
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		%0	0
NEPA costs	Will be conducted by NPS for objective 4.	%0	0
Construction-related support		%0	0
PIT tags	# of tags: 1,000	%1	2,900

Travel		% 1	4,000
Indirect costs	Overhead	% 18	77,350
Subcontractor	Hickey Bros. Consulting, Baileys Harbor, Wisconsin - trapnet expertise	% 3	15,000
Subcontractor	UM Wild Trout and Salmon Genetics Lab - DNA analysis	% 2	10,000
Subcontractor	Consultant to be selected - zooplankton analysis	% 2	10,000
Other		% 0	
TOTAL BPA FY2000 BUDGET REQUEST			\$428,950

Cost sharing

Organization	Item or service provided	% total project cost (incl. BPA)	Amount (\$)
USFWS	Hatchery space, project administration, and facility maintenance	% 24	150,000
National Park Service	Equipment (boats, motors, etc.) and lodging for field crews	% 8	50,000
		% 0	
		% 0	
Total project cost (including BPA portion)			\$628,950

Outyear costs

	FY2001	FY02	FY03	FY04
Total budget	\$405,000	\$420,000	\$350,000	\$350,000

Section 6. References

Watershed?	Reference
<input type="checkbox"/>	Donald, D.B. and D.J. Alger. 1993. Geographic distribution, species displacement, and niche overlap for lake trout and bull trout in mountain lakes. Canadian Journal of Zoology 71:238-247.
<input type="checkbox"/>	Kanda, N. 1998. Genetics and conservation of bull trout: Comparison of population genetic structure among different genetic markers and hybridization with brook trout. Doctoral dissertation. University of Montana, Missoula.
<input type="checkbox"/>	Montana Department of Fish, Wildlife and Parks; Confederated Salish and Kootenai Tribes. 1991. Fisheries mitigation plan for losses attributable to the construction and operation of Hungry Horse Dam. MDFWP and CSKT,

	Kalispell.
<input type="checkbox"/>	Montana Department of Fish, Wildlife and Parks; Confederated Salish and Kootenai Tribes. 1993. Hungry Horse Dam fisheries mitigation implementation plan. MDFWP and CSKT, Kalispell.

PART II - NARRATIVE

Section 7. Abstract

This project implements NPPC Program Measures 10.3A.10, 10.3A.11, and 10.3A.12. We employ fish hatchery production techniques and other innovative approaches to mitigate for Hungry Horse Dam hydro-related losses of 415,000 salmonids annually from the Flathead River/Lake system. The project objectives are two-fold: First, to partially offset lost angler opportunity and reduce pressure on native stocks by planting hatchery fish in offsite waters of the Flathead Basin. Second, to conduct a pilot investigation of methods and baseline conditions, then evaluate the efficacy of removal of introduced species from Lake McDonald in Glacier National Park as a technique for restoring weak but recoverable stocks of native fish. Lake McDonald is a lacustrine ecosystem, which is dominated by introduced lake trout and lake whitefish despite having a relatively pristine and intact watershed. It is directly connected to the Flathead River system and provides an opportunity to mitigate directly for hydropower-related losses. We will use accepted fisheries techniques to net a large portion of the introduced salmonids and evaluate the resultant recovery of native species, making recommendations to enhance habitat or populations where warranted. It is anticipated that the evaluation and removal phase will last three years, with follow-up monitoring for two more years. Implementation of a long-term maintenance plan will be the responsibility of National Park Service fisheries managers. If successful, this adaptive approach may be applied in numerous other waters throughout the Columbia Basin, including several in the Flathead subbasin.

Section 8. Project description

a. Technical and/or scientific background

Hungry Horse Dam, completed in 1952, blocked access from Flathead Lake to 363 miles of tributary reaches and 85 miles of the South Fork Flathead River. This effectively eliminated 40 percent of the available spawning and rearing habitat for adfluvial bull trout and westslope cutthroat trout from Flathead Lake. To mitigate for these losses managers proposed a combination of operational and nonoperational actions (MDFWP/CSKT 1991). The Northwest Power Planning Council (NPPC) voted unanimously on November 12, 1991 (amendment 903(h)) to approve loss statements presented in the Mitigation Plan and directed the agencies to develop a Mitigation Implementation Plan to mitigate for losses of 65,000 juvenile westslope cutthroat trout, 250,000 juvenile bull trout, and 100,000 adult kokanee. On March 10, 1993 the Council

conditionally approved the Mitigation Implementation Plan (MDFWP/CSKT 1993) and directed the emphasis be placed first on habitat restoration and a five-year kokanee stocking test in Flathead Lake, with experimental work in the propagation and/or supplementation of native species. These directives were incorporated into the 1994 Fish and Wildlife Program under Sections 10.3A.10, 10.3A.11, and 10.3A.12.

During the years 1993 through 1997 over 5.0 million kokanee of various sizes were outplanted from Creston National Fish Hatchery (CNFH) into numerous locations in Flathead Lake and the Flathead River. Biological objectives were for 30% first-year survival of stocked salmon and 10% survival to adulthood. The objectives were not met and a fishery failed to develop. Results clearly indicated that kokanee survival in Flathead Lake was severely limited by predation from high population levels of lake trout. Final monitoring activities are now occurring and a final report is in preparation.

Due to biological and political uncertainties over future management direction of Flathead Lake, the Hungry Horse Implementation Group made an adaptive management decision to direct near-term hatchery-based mitigation efforts to offsite resource areas. Negotiations over a new Flathead Lake Management Plan (MFWP and CSKT) and the development of a complementary FERC mitigation program for the lake are continuing. Hence, the stocking of westslope cutthroat trout and rainbow trout in offsite waters, described in objectives #1 and #3 in this proposal, were incorporated into the FY 1999 project proposal approved by the NPPC during September, 1998. In addition, the experimental work with bull trout culture described in objective #3 has continued since 1993.

Donald and Alger (1993) assessed the interaction of bull trout and lake trout in northern Montana, southwestern Alberta, and east-central British Columbia and stated: "It can be concluded that lacustrine populations of bull trout usually cannot be maintained if lake trout are introduced, although there are exceptions within and beyond the study area such as in Glacier and Flathead lakes." They cite numerous examples where the introduction or invasion by lake trout into a lacustrine system dominated by bull trout led to the eventual exclusion of bull trout. They conclude: "Niche overlap and the potential for competition between the two char species are substantial." About the time the publication of their paper occurred in 1993, bull trout numbers in Flathead Lake began to suffer a serious decline from which they have not recovered. This has led to considerable debate over the long-term prospects for the existence of bull trout in this system (Montana Bull Trout Scientific Group 1995). In the fall of 1997 a scientific panel, convened by the Montana Bull Trout Restoration Team, spent three days examining this issue and concluded: "Lake trout have come to dominate the fish community of Flathead Lake since the introduction of the opossum shrimp, and now represent the greatest obstacle to restoring the bull trout population (McIntyre 1998)."

Flathead Lake is one of many lakes within the range that bull trout and lake trout currently overlap where this potential interaction manifests itself. There are at least 30 lakes in the Flathead River basin which support bull trout. At least one-third of these currently have reproducing lake trout populations and in most of them bull trout are

believed to be in various stages of decline or near extirpation (Montana Bull Trout Scientific Group 1995). Examples include Whitefish Lake, Lake McDonald, Kintla, Lower Quartz, Logging, Bowman, Tally, and Upper and Lower Stillwater lakes. Collectively, these lakes may represent a very important portion of bull trout genetic variability and a genetic refugium within the Flathead Basin.

The potential exists throughout the Columbia Basin for illegal, poorly planned, or inadvertent introductions of lake trout or other species to threaten bull trout populations. The hydro system has created many new reservoirs, some of which seem to provide high quality habitat for subadult and adult bull trout. But, the conversion of rivers to reservoirs has also created new opportunities for populations of lake trout and other primarily lacustrine obligate species to establish. Examples of reservoirs at risk of illegal introductions include Lake Koocanusa (Libby Dam, MT), Hungry Horse Reservoir (MT), Revelstoke Reservoir (B.C.), Kinbasket Lake (B.C.), Oldman Reservoir (Alberta), and Lake Billy Chinook (OR) to name a few. Natural lakes (some of which are now dammed) at similar risk of the potential for adverse interactions due to lake trout (existing populations or potential for introduction) include Priest Lake (ID), Lake Pend Oreille (ID), Wallowa Lake (OR), Arrow Lakes (B.C.), Swan Lake (MT), Holland Lake (MT), Lindbergh Lake (MT), Big Salmon Lake (MT) and Kootenay Lake (B.C.). The probability that lake trout will continue to spread or be spread through these systems is high.

Lake McDonald in Glacier National Park is an example of a large (approx. 6,823 acres) glacial lake with a predominantly nonnative fish species assemblage. Around the turn of the century a succession of habitat disturbances and ecological perturbations began in the Lake McDonald basin, accelerating after Glacier National Park was established in 1910. Indiscriminate fish stocking occurred throughout most of the Park's first half-century and the historic native assemblage of westslope cutthroat and bull trout in Lake McDonald is now heavily dominated by an introduced complex of lake whitefish, lake trout and kokanee. The latter two species appeared in Lake McDonald around the 1950's, several decades after their introduction downstream in Flathead Lake (occurring prior to the existence of any State regulatory authority over fish plants). Empirical evidence suggests that lake trout now comprise over 75% of the angler harvest (L. Marnell, Glacier National Park, pers. comm.). Westslope cutthroat comprise less than 5% of the catch and the fishery for bull trout is closed, though anglers rarely encounter them.

Fishery investigations in the Middle Fork Flathead River drainage have indicated substantial interchange of westslope cutthroat trout between the fluvial system and the Lake McDonald drainage, as evidenced by numerous (over a dozen) tag returns of fish marked in the Middle Fork Flathead River and subsequently recovered in the McDonald drainage (S. Rumsey, MFWP, pers. comm.). Lake McDonald and/or the 2.5-mile reach of stream between the lake outlet and the river are important habitat for migratory fish in the Flathead drainage, possibly including fish from Flathead Lake.

The listing of bull trout in June, 1998 as a threatened species under the Endangered Species Act has heightened the concern for the native fish assemblage of large glacial

lakes in Glacier National Park. Introduced species, especially lake trout, are cited in the Final Listing Rule (USFWS 1998) as the causative factor for the near extirpation of bull trout in several GNP lakes, through mechanisms of competition and/or predation.

Development of Objective #4 maintains the commitment within the Hungry Horse program to mitigate for fish losses directly resulting from the construction of Hungry Horse Dam by replacing them elsewhere in the subbasin when it is not feasible to restore those lost resources directly to Flathead Lake. This encompasses implementation under the conceptual framework of the Multi-Year Implementation Plan (MYIP), which incorporates the mitigation objectives of replacing established losses of westslope cutthroat trout, bull trout, and kokanee for the Flathead Subbasin in section 6.6.4.8 .

b. Rationale and significance to Regional Programs

Objectives 1, 2, and 3 of this proposal represent an ongoing effort to satisfy a portion of the loss statement incorporated into the Council Program under amendment 903(h). In addition, they follow the 1994 Council Program directives under Sections 10.3A.10, 10.3A.11, and 10.3A.12, which call for enacting the Implementation Plan.

The Implementation Plan adopts an adaptive management approach and displays a set of decision trees. Under these guidelines, if kokanee reintroduction is determined not to be successful we are directed to proceed with native species restoration and enhancement of offsite fisheries. The 4th Objective of this project proposal, to conduct a pilot program of introduced species removal from Lake McDonald, will satisfy both of these mandates while providing a much-needed and relevant evaluation of the methodology for conducting introduced fish removal from large glacial lakes. In addition, it satisfies broader Program and ISRP direction to emphasize native species restoration.

Flathead River drainage bull trout and westslope cutthroat trout stocks are regionally significant due to: 1.) Genetic isolation at the head of the Columbia River watershed (Williams et al. 1995, Kanda 1998). 2.) The high water quality and large size of Flathead Lake and the remaining interconnected watershed; including Glacier National Park and portions of the Bob Marshall and Great Bear Wilderness areas. 3.) The uniquely large size of the bull trout and adfluvial life history form they exhibit. These factors combine to make recovery of these weak stocks a high priority in the northwest.

c. Relationships to other projects

This project represents the U.S. Fish and Wildlife Service portion of a cooperative partnership between the federal agency, Montana Fish Wildlife and Parks (MFWP), and the Confederated Salish and Kootenai Tribes (CSKT), to replace fishery resources in the Flathead Subbasin that were lost as the result of hydropower development. Projects 9101903, sponsored by MFWP, and 9608701, sponsored by CSKT, focus on watershed restoration. Project 9101901, sponsored by CSKT, focuses on monitoring of fish populations in Flathead Lake to assess progress in offsetting the loss statement. Collectively, these projects interact with a complementary effort currently being

developed as a condition of FERC relicensing of Kerr Dam, whose objective is to replace annual losses of 131,000 pounds of salmonids to Flathead Lake. The combined resources of these mitigation programs greatly enhance the opportunity to mitigate for lost fishery resources. The Service, State, and Tribes interact on these issues through the Hungry Horse Implementation Group and FERC planning negotiations.

In addition, the Service is funding a pilot program in Idaho (Section 6 funding) to remove lake trout from Upper Priest Lake to benefit bull trout. Similar actions will likely be proposed in other watersheds. FERC relicensing of Noxon and Cabinet Gorge dams on the Clark Fork River downstream from Flathead Lake has led to renewed interest in reestablishing that migratory corridor for bull trout. Lake trout populations in Lake Pend Oreille are one potential obstacle to success in that approach. The petitioning and eventual ESA listing of bull trout galvanized several state-led efforts toward recovery of bull trout. A Federal Recovery Plan process for bull trout is now being formed that will continue to put emphasis and focus on the issue of the effects of introduced species on native bull trout and westslope cutthroat trout.

d. Project history (for ongoing projects)

This project (9101904) was initiated in 1992, after the NPPC adopted the Hungry Horse Mitigation Plan (MDFWP/CSKT 1991). In 1993, after the Council adopted the Mitigation Implementation Plan (MDFWP/CSKT 1993), the U.S. Fish and Wildlife Service allocated the use of 70% of the Creston National Fish Hatchery facility to kokanee production under Hungry Horse Mitigation. The Fish Production Coordinator Project, initiated as Project 9101900 in 1992, was merged into project 9101904 at the beginning of FY 96.

Major Results: As per the direction of the NPPC, fish production during 1992 through 1997 focused on kokanee salmon, with over 5 million kokanee of varying sizes stocked into Flathead Lake during that period. Due to a shortage of kokanee eggs, we developed a very successful kokanee broodstock program and produced up to 3.0 million eggs annually during 1995-1997. However, monitoring in the lake indicated that biological success criteria (30% first-year survival and 10% survival to adulthood) were not being met, due primarily to excessive predation by lake trout, and in 1997 the Hungry Horse IG elected to terminate the kokanee program.

During the period 1993 to present we have conducted ongoing fish culture experiments designed to improve techniques for rearing hatchery bull trout and developing bull trout experimental egg supplies. We were extremely successful in those endeavors, rearing two age classes of bull trout from wild egg supplies, and in 1997 completing the first egg take from experimental broodstock. Over 100,000 eggs were collected, with a portion of the resulting fry utilized by laboratories for a variety of research experiments. In the fall of 1998 about 200,000 eggs were collected from the experimental brood and again they are being used in research.

In 1997, upon termination of the kokanee experiment, we shifted focus to rearing of westslope cutthroat trout and rainbow trout for offsite stocking to meet mitigation goals. We started a westslope cutthroat program at Sekokini Springs, a small, newly acquired MFWP facility. During 1998, about 150,000 westslope cutthroat trout and rainbow trout were distributed to offsite waters under the Hungry Horse Mitigation program. Additional fish are being reared for 1999 distribution.

Adaptive Management: The programmatic shift in 1997 from a kokanee restoration program to offsite stocking was an adaptive management decision based on the failure to meet biological criteria established in the Implementation Plan. The offsite stocking of westslope cutthroat trout, and to a lesser extent rainbow trout, will continue into the foreseeable future. The management agencies will work to develop a longer-term management direction, possibly including an offsite fish stocking program to mitigate fishery losses attributed to Flathead Lake. This decisionmaking process involves a complicated mixture of biology and politics and includes the FERC mitigation program for Flathead Lake. The ultimate management direction is not likely to be resolved for three to five years.

In the interim, the MFWP, CSKT, and USFWS have agreed on a strategy designed to provide real and quantifiable mitigation gains for native species within the basin, while conducting a much-needed pilot program to assess the feasibility of nonnative fish removal. This strategy is embodied in the Lake McDonald project described in Objective #4. Since Lake McDonald is in Glacier National Park, the Park Service has been recruited as a partner in this effort. Because the Park is a Federal entity and the Federal Government is required to recover listed species under the ESA, the political and social hurdles to conducting removal of an introduced sport fish species are more easily surmounted within Park boundaries.

Project Reports:

Carty, D., W. Fredenberg, L. Knotek, M. Deleray, and B. Hansen. 1997. Hungry Horse Dam fisheries mitigation: kokanee stocking and monitoring in Flathead Lake, annual report 1996. DOE/BP-60559-3, Bonneville Power Administration, Portland, Oregon.

Deleray, M., W. Fredenberg, and B. Hansen. 1995. Kokanee stocking and monitoring, Flathead Lake – 1993 and 1994. DOE/BP-65903-6, Bonneville Power Administration, Portland, Oregon.

Evarts, L., B. Hansen, and J. DosSantos. 1994. Flathead Lake Angler Survey. Confederated Salish and Kootenai Tribes, Pablo, Montana. DOE/BP-60479-1, Bonneville Power Administration, Portland, Oregon.

Fredenberg, W. 1992. Genetic sampling plan for bull trout in the Flathead River drainage. U.S. Fish and Wildlife Service, Kalispell, Montana.

Fredenberg, W. 1993. Planning considerations for development of a low-cost bull trout isolation and rearing facility. U.S. Fish and Wildlife Service, Kalispell, Montana.

Fredenberg, W. 1993. Collection of juvenile bull trout in the Flathead River drainage, Montana. U.S. Fish and Wildlife Service, Kalispell, Montana.

Fredenberg, W. 1998. Experimental Bull Trout Hatchery – progress report two – experimental broodstock development 1995-1997. U.S. Fish and Wildlife Service, Kalispell, Montana.

Fredenberg, W., P. Dwyer, and R. Barrows. 1995. Experimental bull trout hatchery progress report, 1993-1994. U.S. Fish and Wildlife Service, Kalispell, Montana.

Fredenberg, W. and D. Edsall. 1993. Gas supersaturation monitoring report, Creston National Fish Hatchery. U.S. Fish and Wildlife Service, Kalispell, Montana.

Fredenberg, W., A. Scholz, R. White, M. Tilson, and H. Galloway. 1998. Thyroxine fluctuation and imprint timing in juvenile bull trout. Manuscript submitted to North American Journal of Fisheries Management. U.S. Fish and Wildlife Service, Kalispell, Montana.

Galloway, H., A. Scholz, J. Hendrickson, R. White, M.B. Tilson, and W. Fredenberg. 1994. Evaluation of thyroxine content as an indicator of imprint timing in juvenile bull trout (*Salvelinus confluentus*). Upper Columbia United Tribes Fisheries Center, Technical Report #50, Cheney, Washington.

Hansen, B., J. Cavigli, M. Deleray, W. Fredenberg, and D. Carty. 1996. Hungry Horse Dam fisheries mitigation: kokanee stocking and monitoring in Flathead Lake, annual report 1995. DOE/BP-65903-7, Bonneville Power Administration, Portland, Oregon.

Hungry Horse Implementation Group. 1994. Hungry Horse Dam fisheries mitigation, biennial report, 1992-1993. DOE/BP-60559-2, Bonneville Power Administration, Portland, Oregon.

e. Proposal objectives

Objective #1: Produce native westslope cutthroat trout at Creston NFH.

Up to 100,000 westslope cutthroat trout will be produced annually using traditional fish culture methods at Creston National Fish Hatchery. Fish will be stocked primarily in small lakes within interconnected waters of the Flathead subbasin as offsite mitigation for Flathead Lake. Expected outcome is to produce angler opportunity in order to partially

offset angling pressure on weak but recoverable native stocks in the mainstem Flathead Lake and river system.

Objective #2: Develop experimental techniques for hatchery culture of bull trout.

Continuing experimental efforts will further define the range of options, production capabilities, and problems encountered in hatchery culture of bull trout. Expected outcomes include the production of bull trout eggs and fry for experimental research. These are not available anywhere else and meet a growing demand. Several existing reports outline research to date. The existing experimental fish may be phased out after the 1999 spawning season or plans will be developed for a replacement program, if warranted.

Objective #3: Produce rainbow trout at Creston National Fish Hatchery.

Up to 100,000 rainbow trout will be produced annually at Creston National Fish Hatchery to be stocked in CSKT-managed waters for the purpose of providing offsite mitigation where existing management programs are not currently stocking fish. The three primary waters to be stocked are reservoirs that contain no native salmonid population and are not sufficiently linked to the main Flathead system to provide any risk of interfering with westslope cutthroat recovery actions in the subbasin. Expected outcome is to produce angler opportunity in order to partially offset pressure on weak but recoverable native stocks. Rainbow trout are used in these waters because the habitat is unsuitable for westslope cutthroat. This portion of the program is the lowest priority objective.

Objective #4: Facilitate native species recovery in Lake McDonald in Glacier National Park through a 5-year pilot program to reduce limiting factors.

This is a new objective that has been added to this project in the current proposal. As described in the Technical Background section of this proposal, there is scientific consensus that high population levels of introduced species, especially lake trout, can have a strong depressing effect on populations of native salmonids, particularly bull trout and westslope cutthroat trout. We hypothesize that a substantial reduction in the population level of introduced fishes in Lake McDonald will create an opportunity for native species to recover. Strictly speaking, this is not a research project because we will not be abiding by a strict study design and protocol. Rather, we intend to employ adaptive management techniques, not only in the reduction of introduced species, but also in the management and enhancement efforts to speed up the recovery of native species. This project will consist of a five-year program to:

- 1.) Conduct an initial assessment of fish and zooplankton community composition and structure.
- 2.) Evaluate a variety of trapping and netting methods for passive capture of native and introduced fish species.
- 3.) Assess limiting factors to native species recruitment (i.e. tributary habitat) and where possible coordinate with project #9101903 to assess options to restore or improve habitat.
- 4.) Conduct a two-year effort toward full-scale removal of all introduced fishes.
- 5.) Conduct follow-up surveys to assess fish and zooplankton community composition and structure.
- 6.) Make recommendations for the long-term maintenance of the recovered populations of native salmonids. Some type of maintenance program will likely be necessary to sustain the low levels of introduced species. The methodology and trigger points for such a maintenance program will be a product of this pilot program.

It is further expected that the progress of native species recovery will be slow. Even if, as we believe, the limiting factor for bull trout and westslope cutthroat trout in Lake McDonald is the overwhelming biomass of lake trout and other introduced species, the mere removal of these competing species does not ensure recovery. Rather, removal sets the stage for an ongoing comprehensive effort to let recovery happen. It will require several generations (perhaps 20-30 years) of increasing population levels of native salmonids, close supervision and enhancement of the existing habitat, and an ongoing program of introduced species suppression to fully realize native species recovery goals.

In the event that native species have been reduced to a nonviable level, we may be required to intercede with a supplementation program or some other enhancement to bolster reproductive efficiency of the existing population. But, that is not part of the current proposal. The recent purchase and future development of the Sekokini Springs Natural Rearing Facility, now under the guidance of Project #9101903, would offer a nearby source of hatchery products if needed. A supplementation program will only be initiated if results of the population assessment dictate it is necessary due to the depleted status of native stocks.

This project will yield a number of very useful products for the region. Annual reports will be developed to assess progress and provide updates for those elsewhere in the basin contemplating similar actions. Cooperators will closely watch development of the deepwater trapnet methodology and its potential application to other sites will be monitored. Pre- and post-treatment fish population estimates will provide solid data sets on which to judge the effectiveness and cost-efficiency of such a program. Outputs from this program will be useful in modeling efforts for similar glacial lakes throughout the basin.

f. Methods

Objectives #1, #2, and #3 will be implemented through the use and application of standard fish cultural practices. Fish provided from this project are raised to meet specific objectives of the management programs conducted by our partners, MFWP and CSKT. We attempt to satisfy their requests for particular stocks, strains, and sizes of fish and place those fish in the environment using methods and timing that will maximize their survival and return. It is the intent of this program to use the hatchery products to support an aggressive management strategy that seeks to reclaim lost habitat and restore weak but recoverable stocks of native bull trout and westslope cutthroat trout within the Flathead subbasin.

Objective #4 will require the preparation of a detailed study plan during the first quarter of FY2000, prior to the implementation of field operations. The general methodologies used to accomplish the tasks in Objective #4 are discussed here in some detail:

Task a: Assess existing fish population structure (species composition, age/growth, relative abundance, genetics, and food habits) in Lake McDonald (FY 2000 - FY 2001). Six Merwin nets and at least three deepwater trap nets will be deployed and used to collect a cross-section of fish species in the lake. During the initial phase of the study we will use catch rates, basin morphometry, and trial and error to establish the most productive trapping sites (ie. spatial and temporal locations of concentrations of introduced fishes, such as spawning shoals, etc.). All fish trapped will be marked with a permanent finclip and released, to establish a marked population. Native bull trout and westslope cutthroat trout will be tagged with individually numbered PIT tags or visual implant tags for the purposes of longterm tracking and collection of age/growth parameters. A portion of these native salmonids will be finclipped and the clips used to establish a genetic baseline and comparison to other Flathead subbasin stocks through electrophoresis and/or DNA analysis conducted by the UM Wild Trout and Salmon Genetics laboratory. Once statistical analyses indicate sufficient recaptures of marked fish are occurring to establish a high probability of being able to obtain reliable population estimates, Phase 1 of the trapping (mark and release) will conclude. Phase 2 of the trapping will be the recapture phase during which all fish captured will be examined for marks and introduced species will be removed from the population. When sufficient recaptures have been obtained to provide statistical reliability, population estimates will be developed using standard Petersen Mark-Recapture or other suitable techniques. These population estimates will be the key to assessing the effectiveness of the removal methodology and determining whether sufficient effort and catch are occurring to succeed in removing target levels of the introduced fish population in a two-year period. During Phase 2 trapping, a stratified sample of lake trout stomachs will be collected for food habits analysis to determine their primary food items and potential impacts on native fish populations.

Task b: Assess existing zooplankton community composition and population structure in Lake McDonald (FY 2000 - FY2001). This task will be subcontracted. The intent will be to collect baseline information for a one-year period under the existing fish population structure that can be contrasted and compared to the condition following introduced fish species removal. This information will be useful in assessing zooplankton food sources as a potential limiting factor in future modeling exercises, and to evaluate to what extent zooplankton species composition and population dynamics are being driven from the top down by predation from fishes.

Task c: Evaluate deepwater trapnets, Merwin traps, and/or other techniques for passive capture of native and introduced fishes (FY 2000) in large glacial lakes. This task includes Phases 1 and 2 of the netting operation defined above. Initial scoping, including a site visit and discussions with a consultant operating on Lake Michigan, lead us to believe that deepwater trap nets will be highly effective in removing lake trout and lake whitefish from Lake McDonald. It is our intent to subcontract with Hickey Bros. of Baileys Harbor, Wisconsin, who have decades of experience with this type of gear, to provide initial setup and operational guidance as well as ongoing evaluation of this technology in Lake McDonald. If deployment of these traps is as effective as we anticipate, this will become the primary mechanism for removal of these species from the

lake. Additionally, we will test other active and passive capture techniques such as Merwin traps, electrofishing, and perhaps pound nets, baited setlines, etc. as the need and opportunity arises. Evaluation of these techniques will include a cost-efficiency assessment as well as an analysis of bycatch and survival of nontarget species. This topic will be of primary interest to managers in the region and will be summarized and reported at regional forums.

Task d: Conduct spawning and recruitment surveys and assess limiting factors for native bull trout and westslope cutthroat trout in tributaries to Lake McDonald (FY 2000 - FY 2004). Foot surveys of McDonald Creek (upstream and downstream from the lake), Sprague Creek, and Fish Creek will be conducted to search for spawning activity and redd locations during the fall (bull trout) and spring (westslope cutthroat trout) postspawning periods. Electrofishing of tributary streams will aid in evaluating likely spawning and recruitment areas and establishing species composition. Intensive removal of introduced species from tributary streams by electrofishing or other methods may be necessary if the incidence of nonnative fishes is found to be extensive. Population estimates in these tributaries may be correlated to measurements of available habitat to provide estimates of the potential productive capability of the tributaries. This information can, in turn, be used to provide some estimate of the potential for natural recruitment to foster recovery.

Task e: Conduct full-scale passive and active removal efforts to eliminate, to the maximum extent practical, all introduced fishes from Lake McDonald; including lake trout, lake whitefish, kokanee, rainbow trout, etc. (FY 2001 - FY 2002). Phase 3 of the trapping and netting operation will consist of a full-scale effort to maximize catch of introduced species and remove them to the greatest extent possible. An initial target level will be to reduce lake trout and lake whitefish populations and biomass by at least 50% the first year (2001), and 75-90% by the end of year 2 (2002). If ingress of fish from the Flathead system downstream, via McDonald Creek, is found to be a major problem then some type of weir or barrier (physical or electric) may need to be considered. The ingress problem may fluctuate with variable pulses of the lake trout population in Flathead Lake and will need to be assessed through periodic electrofishing surveys or other more quantitative techniques. At the end of Phase 3 a second mark-recapture effort, modeled after the first, will occur to evaluate the overall rate of success of the removal effort.

Task f: Implement habitat restoration actions as needed to improve spawning and recruitment of native bull trout and westslope cutthroat trout (FY 2003 - FY 2004). Depending on the results of the stream surveys and identification of potential habitat limiting factors it may be feasible to conduct habitat restoration efforts. Techniques for these activities are well-summarized in project proposal #9101903 and may include barrier modification, in-stream habitat enhancement, sediment source abatement, or other measures. At this time it is unknown how extensive or useful restoration or enhancement efforts in this system may be.

Task g: Provide long-term recommendations for maintaining the native species complex in Lake McDonald and assess application of these techniques to other waters in Glacier Park, the Flathead Basin, and the Columbia River system. We will attempt to model stock/recruitment parameters of introduced species, evaluate and model survival rates of juvenile bull trout and westslope cutthroat trout, and ascertain the level and intensity of maintenance that will be required to protect gains made through the removal program. If natural recovery rates are deemed insufficient to meet manager's goals, then supplementation or other artificial enhancements of the native species populations will be considered. We will assess, through small-mesh gillnets or other means, the relative recruitment rate of lake trout compared to pre-removal conditions and develop "trigger" points for resuming removal efforts. We will conduct post-removal evaluations of the zooplankton community, and age and growth parameters of selected fish species. We will make recommendations for implementing removal programs in other waters as appropriate. The long-term goals of this effort are to first reset the balance of native and introduced species in Lake McDonald to a level favorable for the long-term persistence of the natives and secondly provide a long-term maintenance formula that will ensure the prolonged existence of a bull trout and westslope cutthroat trout genetic reserve in this ecosystem.

g. Facilities and equipment

Project staff will continue to work out of Creston Fish and Wildlife Center, a U.S. Fish and Wildlife Service complex located 12 miles east of Kalispell, Montana. The Center includes Creston National Fish Hatchery. Current project employees have existing office space in this complex. All employees of the Service have access to full training and support staff through the Region 6 office located in Denver. This includes technical support for fisheries science as well as administrative support for computer, fax, phones, e-mail, etc.

In addition to the hatchery building and associated raceways, shops, garages, and storage facilities, the complex includes two office buildings, each of which house about 5 staff members. Creston National Fish Hatchery was completed in 1940 and has undergone several upgrades. It is a relatively modern coldwater fish rearing station with 48 outside raceways (a portion of which are under shelter). The hatchery is supplied by a combination of artesian wells and surface springs combining to deliver 10,000-15,000 gpm of high quality rearing water with an annual temperature profile that ranges from about 38-52°F. This water provides excellent rearing conditions for native coldwater salmonids (bull trout and westslope cutthroat trout). A Service-funded project is currently in the planning phase to upgrade the water supply dam and either enclose or treat a portion of the water supply to eliminate the future health risk of fish pathogens.

The Service maintains a full fleet of Service-owned and GSA lease vehicles at Creston. A large lake boat (23' MonArk) will be used in the Lake McDonald portion of the project. It will require some modifications to install hydraulics for lifting nets and towing a work barge, but is large enough and has a full cabin to provide a margin of safety for inclement weather. Six Merwin trap nets previously utilized for the kokanee experiment

are in good condition and will also be deployed on Lake McDonald. The Service also maintains both portable and boat-mounted electrofishing units that may also be used in this program.

The Service has wet lab facilities at Creston, including an ultracold freezer, microscopes, and other equipment for conducting certain phases of the introduced species evaluation and removal. The use of the Creston facility is being provided as an in-kind partnership contribution of the U.S. Fish and Wildlife Service, for the purposes of achieving Hungry Horse mitigation. Up to 70% of the facility has been made available for this purpose since 1992.

In addition, the National Park Service, which maintains a headquarters at West Glacier, Montana will be a cooperator on the Lake McDonald portion of this project. NPS has a full shop, offices, and storage areas and may provide temporary lodging and manpower assistance to the project.

h. Budget

This project has been redirected as a result of adaptive management decisions made by the Hungry Horse Implementation Group (USFWS, MFWP, and CSKT). Fish culture for Flathead Lake has been eliminated and the fish culture program downsized to provide lesser numbers of hatchery fish for smaller offsite waters. The development of Objective #4 is a new strategy to meet the goals of the Hungry Horse Implementation Plan. While evaluating techniques that may be used in the future for addressing limiting factors to the Flathead Lake fishery (i.e. introduced species competition/predation), we will also actively attempt to conserve important genetic resources of native salmonids in the basin (i.e. westslope cutthroat trout and bull trout in Lake McDonald). FTE and personnel costs remain approximately level with FY98, but a major redirection of personnel is occurring from fish culture operations to accomplishment of Objective #4; introduced species removal. Accordingly, hatchery production costs have been reduced (e.g. fish food) and are offset in this proposal by increases in field expenditures for Objective #4. The FY 98 budget was temporarily and voluntarily reduced by \$95,000 during the transition period. This FY99 budget proposal reflects a \$54,000 decrease from previous long-term projections. Initial expenditures for equipment modifications, such as hydraulics, etc. will last the 5-year life of the project. After introduced species reduction has occurred, the final two years of this proposal (FY03 and FY04) reflect reduced manpower needs.

Section 9. Key personnel

Don Edsall – Project Comanager: As comanager, Don is responsible for the achievement of Objectives #1, 2, and 3, the fish culture aspects of this project. Don is the Acting Hatchery Manager at Creston National Fish Hatchery. He oversees day-to-day operations of the hatchery, hatchery budget, and staff of six employees. All fish rearing and stocking requests, fish health and fish cultural decisions, and maintenance and upgrades of the facility are his responsibility. Approximately 25% of the facility and his

time are dedicated to mitigation fish cultural activities. The remainder of his time and efforts go to other fish production and Service-related issues.

Edsall earned B.S. (1972) and M.S. (1976) degrees in Fishery Biology from Colorado State University. He spent 2 seasons as a fish culturist with the Colorado Division of Wildlife and 2+ years with the Bureau of Land Management devising surface protection measures for oil and gas exploration activities on public lands. Edsall then was engaged in coldwater fish cultural work at the Leadville (CO) National Fish Hatchery (1979-1984). Next came positions doing applied research in fish nutrition and fish cultural techniques at the Beulah (WY) Fish Technology Center (FTC), and the Bozeman (MT) FTC. He has published articles in several technical journals on topics including diet evaluations, diet development, and effects of oxygen supplementation on fish growth and health.

Edsall has been the assistant hatchery manager at Creston since 1991, with several stints as acting manager. His expertise is in hatchery operations, management, and improvement; culture of salmonid fishes; and coordination of fish stocking.

Wade Fredenberg – Project Comanager: Wade, formerly the full-time Fish Production Coordinator under this project, is responsible for oversight of Objective #4, the introduced species removal from Lake McDonald. When the project is funded it is anticipated that a Project Biologist will develop the workplan and oversee the daily field operations. Wade will continue to be responsible for program oversight; program liaison with the State, CSKT, and National Park Service partners; program budget; and development of technical reports. This is expected to occupy 25% of his time and the remainder of his position is funded by the Service and dedicated currently to his role as co-lead for the Bull Trout Recovery Plan.

Fredenberg received B.S. (1978) and M.S. (1980) degrees in Fish and Wildlife Management from Montana State University and spent nearly 13 years (1980-1992) as a fisheries management biologist employed by Montana Fish, Wildlife and Parks. His primary emphasis, in a series of progressively responsible positions in Kalispell, Great Falls, Billings, and Bozeman, was on reservoir monitoring and wild trout stream management, culminating in a research project on the effects of electrofishing injury.

Fredenberg was the Service Fish Production Coordinator at Creston from 1992 to 1998, during the life of the kokanee experiment. His expertise is primarily in fisheries management and the application of management concerns to fish culture. He authored or coauthored many of the previous reports developed under this project (see Section 8d., this report).

Section 10. Information/technology transfer

Since 1994, annual progress reports on implementation of the kokanee experiment and of various aspects of the bull trout culture program have been prepared and submitted to BPA. Several of those reports were printed in the BPA green cover series. A manuscript

discussing the implications of thyroxin levels in laboratory bull trout has been submitted to the North American Journal of Fisheries Management. We have consistently sought out opportunities to present our information at the annual International Kokanee Workshops, Montana Chapter AFS meetings, Northwest Fish Culture Conference, and BPA project reviews. With the transition from the kokanee program into the new mitigation direction of introduced species removal and assessment we will continue to seek opportunities for peer review and adaptive changes to our program.

Congratulations!